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ARS 922 (2012) (English): Headed cabbages
-- Specification



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Headed cabbage — Specification



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This African Standard was prepared by the ARSO Technical Harmonization Committee on Agriculture and Food Products (ARSO/THC 1).

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Introduction

Headed cabbage belongs to the "Brassica" family of vegetables, which also include brussels sprouts, cauliflower, Chinese cabbage, kale, and broccoli. It is one of the widely cultivated crops around the world. The scientific name is *Brassica oleracea* (capitata group).

Cabbage structurally consists of clusters of stiff leaves superimposed one over the other in compact layers, giving it a round or globular shape. Several varieties are cultivated worldwide including green, purple, red, and savoy (loose-wrinkled leaves).

The vegetable is a rich source of phyto-chemicals like *thiocyanates*, *indole-3-carbinol*, *lutein*, *zeaxanthin*, *sulforaphane*, and *isothiocyanates*. These compounds are powerful antioxidants and known to help protect against breast, colon, and prostate cancers and help reduce LDL or "bad cholesterol" levels in the blood.

Fresh cabbage is an excellent source of natural antioxidant, vitamin C, vitamin K, essential vitamins such as pantothenic acid (vitamin B-5), pyridoxine (vitamin B-6) and thiamin (vitamin B-1) and also contains an adequate amount of minerals like potassium, manganese, iron, and magnesium. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase*. Iron is required for the red blood cell formation.

Headed cabbage — Specification

1 Scope

This standard applies to headed cabbages of varieties (cultivars) grown from *Brassica oleracea* var. *capitata* L. (including red cabbages and pointed cabbages) and from *Brassica oleracea* L. var. *bullata* DC. and var. *sabauda* L. (savoy cabbages) to be supplied fresh to the consumer, headed cabbages for industrial processing being excluded.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ARS 53, *General principles of food hygiene — Code of practice*

ARS 56, *Prepackaged foods — Labelling*

CAC/GL 21, *Principles for the establishment and application of microbiological criteria for foods*

CAC/RCP 44, *Recommended international code of practice for the packaging and transport of tropical fresh fruits and vegetables*

CAC/RCP 53, *Code of hygienic practice for fresh fruits and vegetables*

CODEX STAN 193, *Codex general standard for contaminants and toxins in food and feed*

ISO 874, *Fresh fruits and vegetables — Sampling*

ISO 2169, *Fruits and vegetables — Physical conditions in cold stores — Definitions and measurement*

ISO 6561-1, *Fruits, vegetables and derived products — Determination of cadmium content — Part 1: Method using graphite furnace atomic absorption spectrometry*

ISO 6561-2, *Fruits, vegetables and derived products — Determination of cadmium content — Part 2: Method using flame atomic absorption spectrometry*

ISO 6633, *Fruits, vegetables and derived products — Determination of lead content — Flameless atomic absorption spectrometric method*

ISO 6634, *Fruits, vegetables and derived products — Determination of arsenic content — Silver diethyldithiocarbamate spectrophotometric method*

ISO 6637, *Fruits, vegetables and derived products — Determination of mercury content — Flameless atomic absorption method*

ISO 7563, *Fresh fruits and vegetables — Vocabulary*

ISO 7952, *Fruits, vegetables and derived products — Determination of copper content — Method using flame atomic absorption spectrometry*

ISO 9526, *Fruits, vegetables and derived products — Determination of iron content by flame atomic absorption spectrometry*

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ISO 17239, *Fruits, vegetables and derived products — Determination of arsenic content — Method using hydride generation atomic absorption spectrometry*

3 Definitions

For the purposes of this standard, the terms and definitions in ISO 7563, and the following terms and definitions apply.

3.1

similar varietal characteristics

the cabbage in each container shall have the same general characteristics

3.2

reasonable solidity

fairly firm for pointed type cabbage and southern Domestic type cabbage. Northern Domestic type cabbage and Danish or Hollander type cabbage shall be firm. "Reasonable solidity" as applied to Savoy cabbage means not soft or puffy; Savoy type cabbage is characteristically loosely formed and rather light in weight.

3.3

puffy

the heads are very light in weight in comparison to size, or have excessive air spaces in the central portion. They normally feel firm at time of harvesting but often soften quickly. They are known as "Balloon Heads" in certain sections.

3.4

seed-stems

those heads which have seed stalks showing or in which the formation of seed stalks has plainly begun

3.5

damage

any injury or defect which materially affects the appearance, or the edible or shipping quality. Worm injury on the outer head leaves or wrapper leaves which materially affects the appearance of the head or worm holes which extend deeply into the compact portion of the head shall be considered as damage.

3.6

well trimmed

the head shall not have more than four wrapper leaves

3.7

fairly well trimmed

the head shall not have more than seven wrapper leaves

3.8

wrapper leaves

leaves which do not enfold the head fairly tightly more than two-thirds the distance from the base to the top

3.9

reasonably firm

the head is not soft and is of reasonable weight for its size but may have considerable open spaces between the leaves in the lower portion of the head

3.10

serious damage

any injury or defect which seriously affects the appearance, or the edible or shipping quality. Cabbage which is affected by soft rot or which is seriously puffy, badly burst, or seriously injured by seedstems, discoloration, freezing, disease, insects, mechanical or other means shall be considered as seriously

damaged. Worm injury on the outer head leaves or wrapper leaves which seriously affects the appearance of the heads, or worm holes which seriously affect the compact portion of the head shall be regarded as serious damage.

4 Provisions concerning quality

4.1 General

The purpose of the standard is to define the quality requirements of headed cabbages at the export control stage, after preparation and packaging.

4.2 Minimum requirements

4.2.1 In all classes, subject to the special provisions for each class and the tolerances allowed, the headed cabbages must be:

- (a) intact
- (b) sound; produce affected by rotting or deterioration such as to make it unfit for consumption is excluded
- (c) clean, practically free of any visible foreign matter
- (d) fresh in appearance
- (e) practically free from pests
- (f) practically free from damage caused by pests
- (g) not split or bolted
- (h) free of bruises and injury
- (i) free of damage due to frost
- (j) free of abnormal external moisture
- (k) free of any foreign smell and/or taste.

4.2.2 The stem should be cut slightly below the lowest point of leaf growth; the leaves should remain firmly attached, and the cut should be clean.

4.2.3 The development and condition of the headed cabbages must be such as to enable them:

- (a) to withstand transport and handling, and
- (b) to arrive in satisfactory condition at the place of destination.

4.3 Classification

The headed cabbages are classified in two classes defined below:

4.3.1 Class I

Headed Cabbages in this class should be of good quality. They must be characteristic of the variety. They should be compact, having regard to the species.

According to the variety, the headed cabbages must have firmly attached leaves. Store headed cabbages may have some of their outer leaves removed. Green Savoy cabbages and early cabbages

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taking into account their variety, must be properly trimmed, but in doing so a number of outer leaves may be left for protection.

Green headed cabbages may be superficially frosted.

The following slight defects, however, may be allowed provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package:

- small cracks in the outer leaves
- slight bruising and light trimming of the outer leaves.

4.3.2 Class II

This class includes headed cabbages which do not qualify for inclusion in Class I, but satisfy the minimum requirements specified above.

The following defects may be allowed provided the headed cabbages retain their essential characteristics as regards the quality, the keeping quality and presentation:

- cracks in the outer leaves
- outer leaves may be removed
- larger bruises and the outer leaves may be more extensively trimmed
- less compact.

5 Provisions concerning sizing

Size is determined by net weight. This must not be less than 350 g per unit for early cabbages and 500 g per unit for other headed cabbages.

Sizing is compulsory for headed cabbages presented in packages. In that case, the weight of the heaviest head in any one package must not be more than double the weight of the lightest head. When the weight of the heaviest head is equal to or less than 2 kg the difference between the heaviest and the lightest head may be up to 1 kg.

The size requirements shall not apply to miniature produce.¹

6 Provisions concerning tolerances

Tolerances in respect of quality and size shall be allowed in each package, or in each lot for produce presented in bulk, for produce not satisfying the requirements of the class indicated.

6.1 Quality tolerances

6.1.1 Class I

10 per cent by number or weight of headed cabbages not satisfying the requirements of the class, but meeting those of Class II or, exceptionally, coming within the tolerances of that class.

6.1.2 Class II

¹ Miniature product means a variety or cultivar of vegetable, obtained by plant breeding and/or special cultivation techniques, excluding specimens of non-miniature varieties which have not fully developed or are of inadequate size. All other requirements of the standard must be met.

10 per cent by number or weight of headed cabbages satisfying neither the requirements of the class nor the minimum requirements, with the exception of produce affected by rotting or any other deterioration rendering it unfit for consumption.

6.2 Size tolerances

For all classes: 10 per cent by number or weight of headed cabbages not satisfying the requirements as regards:

- uniformity
- minimum size.

However, no head may weigh less than 300 g in the case of early cabbages and 400 g in the case of other cabbages

7 Provisions concerning presentation

7.1 Uniformity

The contents of each package or lot for produce presented in bulk, must be uniform and contain only headed cabbages of the same origin, variety, quality, and size (if sized).

Cabbages classed in Class I must be uniform in shape and colour.

The visible part of the contents of the package, or lot for produce presented in bulk, must be representative of the entire contents.

Miniature headed cabbages must be reasonably uniform in size. They may be mixed with other miniature products of a different type and origin.

7.2 Packaging

The headed cabbages must be packed in such a way as to protect the produce properly.

The materials used inside the package must be new, clean and of a quality such as to avoid causing any external or internal damage to the produce. The use of materials, particularly of paper or stamps bearing trade specifications is allowed provided the printing or labelling has been done with non-toxic ink or glue.

Packages, or lots for produce presented in bulk, must be free of all foreign matter.

7.3 Presentation

Headed cabbages may be presented

- packed or
- in bulk.

8 Marking or labelling

8.1 Consumer packages

In addition to the requirements of ARS 56, the following specific provisions apply:

8.1.1 Nature of produce

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If the produce is not visible from the outside, each package shall be labelled as to the name of the produce and may be labelled as to the name of the variety and/or commercial type.

8.2 Non-retail containers

Each package² must bear the following particulars, in letters grouped on the same side, legibly and indelibly marked, and visible from the outside:

For headed cabbages transported in bulk (loaded directly into a vehicle), these particulars must appear on a document accompanying the goods and be attached in a visible position inside the transport vehicle.

8.2.1 Identification

Name and address of exporter, packer and/or dispatcher. Identification code (optional).³

8.3.2 Nature of produce

— "White headed cabbage", etc. ... if the contents are not visible from the outside.

8.2.3 Origin of produce

Country of origin and, optionally, district where grown, or national, regional or local place name.

8.2.4 Commercial specifications

- Class
- Net weight or number of units.
- Mini headed cabbages, baby headed cabbages, or other appropriate term for miniature produce. Where several types of miniature produce are mixed in the same package, all products and their respective origins must be mentioned.

8.2.5 Official control mark (optional)

9 Contaminants

9.1 Heavy metals

Headed cabbages shall comply with those maximum levels for heavy metals established by the Codex Alimentarius Commission for this commodity. The current limits are as indicated below:

Metal	Unit of measurement	Maximum limit	Test method
Lead (Pb)	mg/kg wet weight	0.30	ISO 6633 (AAS)
Cadmium (Cd)	mg/kg wet weight	0.050	ISO 6561-1 or 6561-2

9.2 Pesticide residues

Headed cabbages shall comply with those maximum pesticide residue limits established by the Codex Alimentarius Commission for this commodity.

² Package units of produce prepacked for direct sale to the consumer shall not be subject to these marking provisions but shall conform to the national requirements. However, the marking referred to shall in any event be shown on the transport packaging containing such package units.

³ The national legislation of a number of countries requires the explicit declaration of the name and address. However, in the case where a code mark is used, the reference "packer and/or dispatcher (or equivalent abbreviations)" has to be indicated in close connection with the code mark.

10 Hygiene

10.1 It is recommended that the produce covered by the provisions of this Standard be prepared and handled in accordance with the appropriate sections of ARS 53, CAC/RCP 53, and other relevant Codex texts such as Codes of Hygienic Practice and Codes of Practice.

10.2 The produce should comply with any microbiological criteria established in accordance with CAC/GL 21.



Head cabbage (*Brassica oleracea* L.)



Savoy cabbage with tight head



Savoy cabbage



Round headed cabbage



Headed cabbage



Early Deep-Head Cabbage



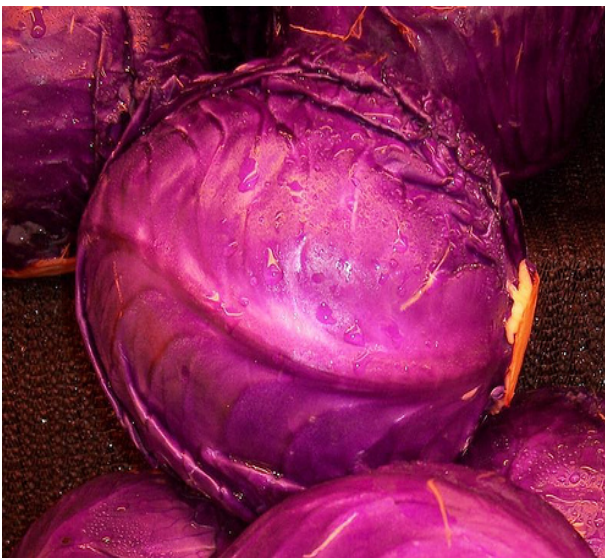
A "purple" flowering cabbage



Round headed cabbage



Purple headed cabbage



Purple headed cabbage



Red Cabbage



Cabbages in farm



Typical round headed cabbages



Growing cabbages



Cabbage field

Annex B (informative)

Storage in the open

B.1 Scope and field of application

This annex lays down guidelines relating to the technique of storing round-headed cabbage (*Brassica oleracea* var. *capitata* Linnaeus sv. *alba* and *Brassica oleracea* var. *capitata* sv. *rubra*) outdoors, to allow a quality suitable for consumption or industrial use to be maintained.

Cold storage of round-headed cabbage is practically unknown in a number of countries; on the other hand, storage in enclosed spaces, without artificial cooling, is better known, but most round-headed cabbage is commonly stored in clamps (temporary silos) constructed outdoors. This has resulted in the storage technique being largely dependent on local conditions, but, although the simple methods of storage are very well known, it is also necessary to describe them.

B.2 Harvest and storage conditions

B.2.1 Cultivars

The storage techniques described apply equally to all cultivars of cabbage, the keeping of which is of economic interest. Differences due to the weather, soil conditions and other environmental factors in various regions and growing areas, are considerably greater than differences in cultivars.

However, cabbages of the late cultivars are generally more suitable for storage; so are cabbages grown in light or semicompact soil.

B.2.2 Harvest

Cabbages intended for storage shall be ripe, headed and firm. A late harvest favours cracking during storage.

Cabbages harvested from humid soils are less suitable for storage, and irrigation should, therefore, be stopped at least 15 days before harvesting. They shall be harvested in dry weather, at a temperature below 10 °C. The optimum temperatures range from 0 to 5 °C. To avoid damage caused by freezing, cabbages shall not be harvested, handled or transported at the outdoor temperature is below 0 °C. It is recommended that cabbages harvested in wet weather be allowed to dry before storage.

The stem of the heads shall be cut between 1 and 2 cm below the level of the outer leaves; the cut shall be clean and smooth.

B.2.3 Quality

Cabbages intended for storage shall be whole, fresh in appearance, undamaged, sound and healthy, clean, and, in particular, free of soil and traces of water. Heads showing signs of attack by parasites or diseases or showing pronounced bruises or deterioration due to freezing shall be rejected.

Before storage, it is convenient to remove dead or damaged outer leaves from the heads.

Heads having a mass between 2 and 2.5 kg are most suitable for storage in the open air.

B.2.4 Putting into store

Cabbage of convenient maturity and suitable for storage shall be put into store as quickly as possible after harvesting. Prior to putting into store, however, the crop shall be dried in a ventilated place

protected against frost. During drying, the outer leaves lose their brittle character and adhere tightly to the head. Dried cabbages are less sensitive to damage and disease. The duration of drying shall be 36 to 48 h when cabbages are not sufficiently dry during selection.

It is recommended that cabbages be stored at low temperatures.

B.2.5 Method of storage

The clamp (a cabbage pile of a roughly triangular cross-section) shall be situated in a location sheltered from water or atmospheric condensation, orientated, if possible, to take into account the prevailing Winds. The depth, height, covering and ventilation of clamps vary according to country; different types of clamps may be combined:

- clamps with or without ventilation channels;
- clamps with or without covering;
- underground or soil surface clamps.

Underground clamps provide better storage conditions, notably more uniform temperatures and humidities. However, these types of clamp can be installed only in light and sandy soils and in dry soils. Soil surface clamps are constructed on compact and heavy soils and on wet soils; in this case, the ground has to be level and clean.

The clamps may be of different sizes. For small clamps (width 1 to 1.2 m, ventilation channels are not usually provided. Such clamps are covered successively with thin layers of insulating materials above the cabbages and by thicker layers of material towards the outside. This allows the required conditions of ventilation to be obtained when the internal temperature drops. In these small clamps, the amount of heat evolved by the cabbages in respiration is lost through the covering layers of the clamps. Also, in clamps without ventilation, the carbon dioxide content increases due to respiration, which is advantageous for the stored cabbage.

Larger clamps (width 1.5 to 2.0 m) have to be ventilated in order to be quickly cooled and to expel the excessive heat evolved during respiration in the larger clamps after the cabbage is stored in the autumn. The ventilation channels have to be covered or uncovered according to the internal and external temperatures of the clamp.

The depths of underground clamps may be 20 to 60 cm. The ventilation channel, constructed from boards, shall be placed along the longitudinal axis of the clamp with its end protruding for a few centimetres.

Ventilation systems vary according to country. Ventilation of the clamps shall be assured by

- horizontal ventilation channels, of internal dimensions 20 to 30 cm and 40 to 50 cm longer at both ends than the base of the clamp;
- vertical ventilation channels, of internal dimensions 15 to 20 cm, of height 150 to 180 cm, and 40 to 50 cm higher than the clamp. Allowance should be made for channels every 2 m.

The recommended width of clamps is between 100 and 180 cm, and the corresponding height is from 70 to 140 cm (although other recommendations require a minimum width of 1160 cm, with a permissible clamp height of up to 200 cm). The length of the clamp may be from 15 to 25 m.

The clamp base shall be covered with a layer of clean straw, 10 to 15 cm thick. For outdoor storage in clamps, provision should be made for 15 kg of straw per 100 kg of cabbage. Planks or open-work (lattice) crates may also be used as the foundation. The cabbages should be placed in rows with the cores pointing upwards. Each layer should contain cabbages of the same size.

The choice of the method of storage of cabbages in clamps depends upon local circumstances and conditions, but should guarantee that

- in autumn, cabbages are cooled as quickly as possible to a temperature of 0 to +1.0 °C;
- low and constant temperature and uniform humidity are maintained throughout the clamp for the full duration of storage;
- there is protection against the temperature dropping below 0 °C.

The methods and materials used for covering the clamps vary according to local conditions and depend on the ambient temperature and atmospheric humidity. The most important factor, however, is the rate of atmospheric precipitation. Thus the following may be used:

- a covering of earth (sand) in layers, directly over the cabbages;
- a single cover put directly on the clamp surface only;
- covering of the clamp with straw, cornstalk or other similar material, protected by a plastic film
- a straw cover combined with an external covering of earth;
- covering with any other material locally available.

It is not necessary to provide a ventilation system if the stored cabbage has been pre-cooled and if there is only a thin covering. For this purpose, the heads of cabbage are stored in two or three layers, in a 300 cm wide clamp, sunk into the ground and covered with a layer of light sandy soil. The covering should allow the cabbage to cool as quickly as possible. When the temperature of the cabbage falls to 0 to +1 °C, and the outdoor temperature is below freezing point, it is necessary to use a thicker covering, for example an earth layer, 10 to 20 cm thick, then over this, a straw layer 20 to 25 cm thick, and another earth layer, 10 to 15 cm thick. Such covering will be sufficient in the case of temperatures down to -20 °C. At lower temperatures, the thickness of the covering has to be increased.

The different storage methods and the various climatic conditions do not permit specification of the dimensions for clamps. The following data is given for information only.

Dimensions of clamp	Ground area of clamp	Mass in one clamp	Ground area required for 10 t
cm	m ²	t	m ²
150 × 120 × 2500	37.5	7.4	300
200 × 170 × 2500	50.0	14.0	175

The mass of 1 m³ of cabbage is about 350 kg, and, in the case of red cabbage, about 450 kg.

Clamps should be placed with the longitudinal sides at least 5 to 6 m apart without the cover; the ends of the clamps should be at least 3 m apart.

B.3 Optimum storage conditions

Values for temperature, relative humidity, and ventilation rates for clamps in the open cannot be exactly specified, as these parameters are difficult to control and depend on the predominant weather conditions. For this reason, this annex does not specify the conditions of storage but specifies the operations necessary for their determination.

B.3.1 Optimum temperature and its control

During storage, the temperature of the clamp should be checked three times a week during autumn, and at least twice a week in winter.

The optimum storage temperature is from 0 to + 1 °C. It is necessary to ensure that the temperature in the clamp does not fall below freezing point for extended periods.

It is equally dangerous if the temperature in the clamp exceeds 5 to 6 °C, and a temperature greater than 8 °C can provoke deterioration.

The temperature shall be measured by means of a thermometer at places 10 m apart along both sides of the clamp. At each place, the thermometer shall be introduced half way up the clamp side, perpendicularly to the layer of earth, and at a depth such that the end of the thermometer reaches the upper surfaces of the cabbages in the clamp. It shall be left from 15 to 20 min in the clamp before the temperature is measured.

The clamps shall be regularly checked during storage and all cracks and gaps shall be blocked up. If the outside temperature falls to freezing point, and if the clamp is not covered with snow, it is necessary to protect it by additional layers of earth. For this purpose, corn stalks, straw covered by tarpaulin etc., followed by another layer of earth, may be used.

During checking, a collapsed edge, a slumped side, or snow melting more quickly in certain places, is a sign of putrefaction of the cabbages.

Sporadic putrefaction of the outer leaves is not a hazard to the stored cabbages, but in the case of significant areas of putrefaction, the clamp must be demolished.

If the external air temperature remains at about 5 °C for 4 to 5 days, the earth layer shall be removed; above 10 °C, cabbages cannot be kept for more than a short time.

B.3.2 Relative humidity

The Optimum relative humidity is from 85 to 90 % (0.85 to 0.90); it should be higher, rather than lower, than this value.

B.3.3 Covering of the clamps

The constructed clamp shall be loosely covered with a soft straw layer, 20 to 25 cm thick. This straw layer can be made thicker or covered with earth if the external temperature falls to -1 to -2 °C, or when the cabbage has properly cooled off.

Earth can also be used directly to cover the clamp — as straw, in contact with the cabbage, may cause mould to grow on the cabbage — by placing a layer of earth only a few centimetres thick over the cabbages. When the clamp has cooled and prior to the advent of a stronger frost, cover the clamp with straw, or any other insulating material, or with a second layer of earth.

If the external temperature continues to decrease and the temperature in the clamp approaches, or reaches freezing point, apply a further layer of earth to the clamp. This settled earth layer shall be of a thickness of about 10 cm. Frozen earth shall not be used. For this purpose, cover the soil adjacent to the clamp, to a width of 50 to 60 cm, with a layer of straw 5 to 10 cm thick prior to the advent of the first frost. Use the earth from under the straw layer for extra covering.

Covering clamps is also important in places where the autumn temperature does not approach freezing point. In this case, cabbage under the thin covering will cool off during the night and warm up less in the day-time.

B.3.4 Sorting and termination of storage

If the outside temperature exceeds +5 °C for a long time, a careful check must be made for damage due to putrefaction. Extensive rot may necessitate the opening of the clamp, thus terminating storage. This is achieved by dismantling the clamp. The cabbages shall be removed from one end (face) of the clamp. They shall be removed by hand as the use of forks may impair the quality. The opened clamp shall be covered again if there is a risk of frost, but such covering shall be exclusively with straw.

The cabbages should be carefully sorted and the outer withered or rotten leaves should be removed; the stem should be cut shorter. Afterwards, the recovered cabbages may be marketed after vigorous grading to ensure a quality in accordance with this standard.

B.4 List of round-headed cabbage varieties recommended for long periods of outdoor storage

Producing country	Recommended varieties
Hungary	Amager, Danish durable, and some regional varieties
Netherlands	Langedijker bewaarwitte, Langedijker bewaargele, Langedijker bewaar-rode
Poland	Langedijker, white and red, Kamienna Glowa, Zimowa z Mor
Romania	White: Amager, Braunschweig, de Buzau, Licurisca
	Red: Arges, L 403, Cap de negru
Russia	Amager, Zirnovka, Beloruskaja, Podarok

NOTE The list of recommended varieties will be completed later when further information is available from other cabbage producing countries.

B.5 Comments

The following comments refer to the role of the area of production and to unforeseen difficulties of storage.

B.5.1 Role of the area of production (Ecological and production method influences)

These influences, which manifest themselves in the case of round-headed cabbage put into cold store, are equally valid in the case of cabbage stored in clamps.

The following are especially unfavourable influences:

- premature or late harvest, having possibly run to seed;
- heads not sufficiently compact;
- soils over-treated with nitrogenous fertilizers, or moist and compact soils;
- harvest in the rainy season, wetness of the cabbage;
- lesions caused by frost, excessive loss of leaves, or stems cut too short.

B.5.2 Unforeseen difficulties in storage

Taking into account the range of diseases which can occur in storage, only a brief review is given.

B.5.2.1 Moisture or frost

Cabbage stored in a moist or frozen condition may become fusty. This can be prevented by appropriate treatment, for example in the case of fustiness that has not yet spread extensively, by selection, moving and cooling, after which the sound heads can remain in storage. In more serious cases, and after the apparition of mould, the cabbages are no longer worth storing in clamps.

B.5.2.2 Freezing

The outer leaves of frozen cabbage are brittle, and wither and turn yellow after having been thawed. On cutting, the leaves appear vitreous and brown. After thawing, frozen cabbage must be used immediately as it cannot be further stored.

B.5.2.3 Grey mould (*Botrytis cinerea*)

This appears usually on moist, fusty, or damaged cabbages. The diseased leaves are covered by a layer of grey mould under which the leaves will brown and decay. The advent of grey mould can be prevented by careful handling during preparation and storage, and by protecting the cabbages from mechanical damage.

B.5.2.4 Black vein (*Pseudomonas campestris*)

The plant becomes infected with microbes in the area of production. The microbes propagate within the veins of the cabbage leaves, making the veins black. Often the disease is only visible after splitting the head. The diseased cabbage should not be used even for forage.

During selection, check for bacterial infection by boring and store only the cabbages showing no signs of infection.

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Annex C (informative)

Guide to cold storage and refrigerated transport

C.1 Scope

C.1.1 This annex gives guidance on the operations to be carried out before and the conditions to be met during the cold storage and refrigerated transport of round-headed cabbages (*Brassica oleracea* L. var. *capitata* L., and *Brassica oleracea* L. var. *sabauda* L.), for maintaining quality and avoiding deterioration.

This annex is applicable to roundheaded cabbages intended for human consumption.

C.1.2 This annex gives general recommendations for the cold storage and refrigerated transport of round-headed cabbages.

These recommendations may need to be modified to suit particular cultivars of round-headed cabbage, local climatic conditions, cultivation practices and market requirements, distances of transportation, etc. Experts will be able to establish those recommendations most appropriate for particular market requirements, and ecological and agrotechnical factors. In addition, the quality of the harvest and the storage conditions attainable in particular transport vehicles and cold stores may necessitate modifications to these recommendations.

Subject to local conditions and the fact that cabbages are living matter, the application of the recommendations made in this annex should enable much wastage during refrigerated transport and cold storage to be avoided.

C.2 Conditions of harvesting and storage

C.2.1 Harvesting

Cabbages should be harvested when ripe (firm “head”), i.e. when the size and form of the head of the cabbage is characteristic of the cultivar in question, and during a period of dry weather.

NOTE 1 Premature harvesting may lead to an excessive tendency of the cabbages to wither and, conversely, delayed harvesting may induce bursting of the cabbages.

The best period for harvesting is early in the morning, in dry weather, in the absence of dew and, in the case of irrigated cultivation, 10 days to 15 days after the last irrigation (in order to avoid excessive turgidity of the tissues, cracks in the heads and rotting leaves).

Cabbages harvested in wet weather should be allowed to dry before being stored and transported.

Cabbages damaged or frozen, even partially, should be rejected.

The butt should be cut off slightly below the point from which the outer leaves originate, the latter remaining firmly attached. The cut should be made cleanly and the butt should have a maximum length of 3 cm, in order to avoid cabbages being damaged by mechanical action during handling.

C.2.2 Characteristics for storage

Cabbages intended for storage should be sound, of good quality, not run to seed and, depending on the cultivar, of mass 1.6 kg to 3 kg for white cabbage, and 1 kg to 2 kg for red cabbage.

Cabbages should be free from disease and physiological defects.

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The heads should be well covered and free from parasites, bruises and damage or injuries due to frost. They should be clean and free from earth fragments or other foreign materials. Their content of agrochemical product residues should not exceed the limits established by the relevant producing or importing country.

The heads should be free from abnormal surface moisture. They should be covered by at least one layer of outer leaves.

C.2.3 Place of storage

Cabbages should be stored in refrigerated cells of maximum capacity 500 t; the cells should be previously disinfected, free from insects and vermin, aerated and cooled.

The storage of cabbages in the vicinity of products which emit ethylene should be avoided since this may affect the quality of the cabbage by inducing cracks in the head of the cabbage and yellowing and abscission of the leaves.

The time taken to fill a cell should be no longer than 7 days.

C.2.4 Method of storage

Cabbages may be stored in bulk or in standardized containers.

Cabbages stored in bulk should be ventilated in the vertical direction, and the depth of cabbages in any stack should not exceed 3 m.

Cabbages stored in standardized containers should be ventilated in the vertical or in the horizontal direction or in top-ventilated cells. The height of stacks should not exceed 6 m, and a minimum free space of 80 cm should be left between the top row of containers and the ceiling of the cell. The cabbages should be arranged in rows with their butts facing upwards.

The storage system should ensure good air circulation; it is therefore necessary to leave a space of 5 cm to 10 cm between stacks, and a space of about 65 cm between stacks and the wall.

C.3 Optimum storage conditions

See ISO 2169.

C.3.1 Air temperature

The average air temperature in the cold store should be maintained between 0 °C and 1 °C.

The temperature at the centre of a stack should also be between 0 °C and 1 °C, although white cabbage is able to tolerate a temperature of -0.8 °C.

NOTE 2 Reducing the temperature to below -0.8 °C may cause decomposition of leaf tissue.

Owing to the respiration of cabbages, the temperature at the centre of a stack will increase rapidly if the stacking pattern is incorrect and the ventilation inadequate, and therefore the product temperature should be monitored within representative stacks.

C.3.2 Relative humidity

The relative humidity should be maintained between 90 % and 98 %.

C.3.3 Air circulation

The air circulation during storage and transportation should be such (0.25 m/s to 0.40 m/s) that the temperature and relative humidity specified in C.3.1 and C.3.2 are maintained constant and uniform.

C.3.4 Storage life and quality control

The storage life of cabbages depends on the cultivar, the quality and the storage conditions (see C.6). The storage life of most cultivars falls into one of three categories: short term (3 months to 5 months), midterm (4 months to 6 months) and long term (5 months to 7 months).

During the storage period, regular quality control of the product should be carried out.

C.4 Operations at the end of storage

Before marketing, it is necessary to examine cabbages and to discard yellowed or diseased outer leaves, to retrim the butt if necessary, and to discard split or rotten heads.

C.5 Refrigerated transport

To maintain their quality during transportation, cabbages should be packed in containers standardized in the country concerned.

The duration of transport may be 2 days to 3 days at a temperature of 0 °C to 15 °C, or 8 days to 10 days at a temperature of 0 °C to 1 °C.

C.6 Influence of horticultural factors on storage life 1 and defects arising during storage**C.6.1 Influence of horticultural factors on storage life**

Certain ecological or agrotechnical factors have an adverse effect on the storage life of cabbages. These factors may be summarized as follows:

- a) cabbages which are harvested too early or too late (e.g. cabbages which have burst or run to seed);
- b) cabbages (particularly spring, summer and autumn varieties) having leaves which are excessively curled and which do not adhere tightly to the head;
- c) cabbages from land which has been over-treated with nitrogenous fertilizer;
- d) cabbages harvested in wet weather;
- e) cabbage heads damaged by lesions caused by frost (see note 3) or which have lost most of their leaves or which have had too much of their tops knocked off.

NOTE 3 Certain cultivars of green cabbage which are resistant to cold are able to withstand temperatures slightly below 0 °C but not freezing.

C.6.2 Defects arising during storage

In general, a distinction is made between damage of physiological origin and damage of biological origin.

C.6.2.1 Physiological damage

Physiological damage may be characterized by

- a) desiccation of the outer leaves, owing to insufficient relative humidity during storage;
- b) a glassy appearance of the leaves when the storage temperature has been too low (freezing); the leaves will turn brown on warming;
- c) the appearance of small brown specks, owing to lack of oxygen during storage (lack of oxygen occurs when the cabbage or its container is covered with plastic film);

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- d) loss of the outer leaves or bursting, due to physiological disorders.

C.6.2.2 Biological damage

Biological damage may be due to bacterial decomposition such as 'blackening of the veins, caused by *Pseudomonas campestris*, or fungal deterioration.

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